VOL. XVI. JUNE, 1891. NO. 6.

THE BOTANICAL GAZETTE

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[ISSUED JUNE 15.]

CRAWFORDSVILLE, INDIANA.
PUBLISHED BY THE EDITORS.

Tracy, Gibbs & Co., Printers, Madison, Wisconsin.

THE BOTANICAL GAZETTE.

A Monthly Journal Embracing all Departments of Botanical Science.

ANNUAL SUBSCRIPTION, $2.50.

SINGLE NUMBERS, 25 CENTS.

The subscription price is an invariable one, no concession being made to dealers or agents.

In Great Britain, 11 shillings.	In Germany, 11 marks.
Agent, W. P. COLLINS,	Agent, R. FRIEDLÄNDER & SOHN,
157 Great Portland St., London, W.	11 Carlstrasse, Berlin, N. W.

Subscriptions and correspondence should be addressed to ***Charles R. Barnes, 712 Langdon St., Madison, Wisconsin;*** money orders and drafts should be made payable to the BOTANICAL GAZETTE.

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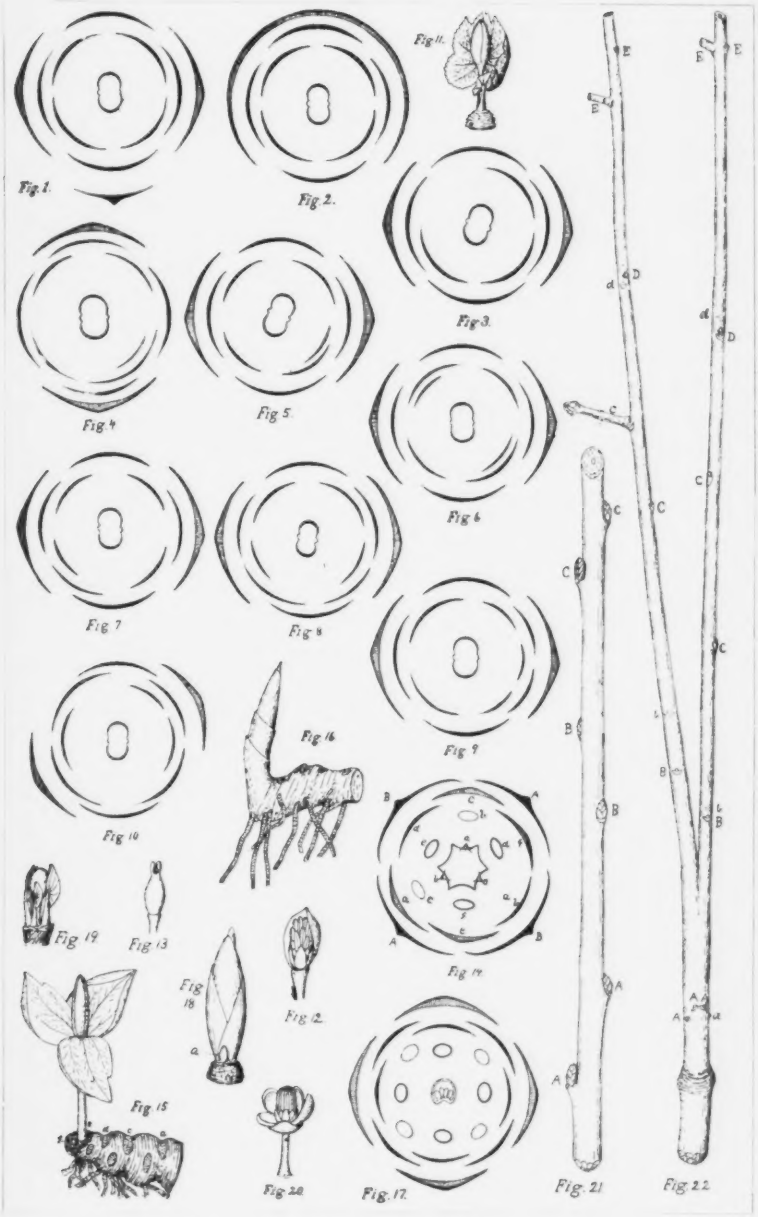

FOERSTE on PHYLLOTAXY

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VOL. XVI. NO. 6.—BOTANICAL GAZETTE.—JUNE, 1891.

Abnormal phyllotactic conditions as shown by the leaves or flowers of certain plants.

AUG. F. FOERSTE.

(WITH PLATE XIV.)

Sanguinaria Canadensis.—Baillon interpreted the flowers of the blood-root so as to make the petals form two decussating dimerous whorls, which by dedoublement have become whorls of four petals each. The petals of the inner whorl should therefore be directly superposed to those of the outer whorl, and the two sepals should occupy a position intermediate between two petals of the outer whorl in each case. Eichler, in his important work "Blüthendiagramme," copies this view. Unfortunately this interpretation is incorrect, as may be seen at any locality where the blood-root is at all common. For the purpose of the following notes many hundreds of flowers were examined, and the accompanying diagrams illustrate all the cases found.

It is not a rare occurrence in some, perhaps isolated, localities to find a single scale about half way up the flower peduncle, subtending a second flower. In this case the sepals of the subtended flower seem to occupy a position transverse to that of the scale. The outer set of four petals is interpreted as consisting of two dimerous whorls, the lower pair of petals decussating with the sepals, and the other pair of petals taking a position directly above the sepals. The inner set of four petals alternates with the outer set taken as a whole, and may be interpreted either as a dimerous whorl decussating with the second pair of petals, and numbering four in consequence of dedoublement, or as a whorl of four petals, showing the usual arrangement of whorls consisting of four members preceding or following dimerous whorls. The latter interpretation is shown to be the correct one by such cases as are represented by fig. 3, in which the inner whorl of petals is reduced to three, but the odd petal never occupies a median position above one of the outer petals, as it should if it represented the undivided petal of a dimerous whorl. The pistil consists of two leaves, which typically decussate with

the sepals, so that the position of the sepals can be determined even when they have fallen off, which they do as soon as the flower opens. This typical arrangement of the flowers is illustrated in fig. 1. The stamens have been omitted from this diagram because nothing definite could be determined regarding their arrangement. However, the fact that the leaves forming the pistil decussate with the sepals suggested the following interpretation. The stamens are too numerous to be interpreted as a single whorl, even if dedoublement be allowed its play, especially when it is considered that *Canbya*, showing the smallest number of stamens known, six, possesses at least two whorls of stamens, and that most species demand a greater number. The blood-root must have more than two whorls in order to make the pistil leaves decussate in regular succession with the previous whorl, and with the sepals. Three whorls at least are therefore represented by the stamens, but for the present all question of dedoublement must be left undecided.

During the examination of a great number of flowers belonging to the same species it was to be expected that anomalous forms would be found Most of these were isolated cases, such as a single sepal, evidently formed by the junction of the two ordinary sepals, fig. 2; or the more important case of sepals occupying a position directly beneath the pistil leaves, fig. 4, in which case it is necessary to assume an even instead of an odd number of staminal whorls in order to explain away their abnormal position, or rather the abnormal position of the pistil leaves. Slightly diagonal positions of the sepals are occasionally met with, but the extreme cases, such as that illustrated in fig. 10, are almost always more apparent than real, and rest upon the fact that the attachment of the sepals at their base takes up about half of the circumference of the peduncle at this point. As this base, however, represents the linear area from which the development of the sepals proceeded, a slight extension of this area to the right or the left often serves to place the indefinite median line of the sepals in a position more or less oblique to the remaining members of the flower. These exceptional conditions are mentioned only for the sake of completeness.

A far more interesting group of variations from the typical arrangement first described is that shown by the petals, and when the great frequency of such variations from the type is

considered, the fact that they can all be reduced to a few series is extremely interesting. It is especially to be noted that the abnormal conditions immediately to be cited, regarding the arrangement of the petals, have no subsequent effect upon the position of the pistil leaves, and therefore can not consist in the interpolation of new whorls of petals, but must arise from dedoublement and the new conditions which dedoublement in preceding whorls often forces upon those which immediately succeed. The most common case consists in the addition of one, figs. 4 and 5, or two petals, fig. 6, to the inner whorl of petals, in such a manner that they take a diagonal position in the flower diagram, more or less approaching the transverse position which a dimerous whorl should take if it were added to the whorls already existing. That these petals are not to be interpreted in this way, but as formed by dedoublement in the nearest petals, is suggested by the unchanged position of the pistil leaves, as already mentioned. A second case consists in the removal of one, fig. 7, or two petals, fig. 8, belonging to the inner whorl of four petals, to the middle dimerous whorl, thus giving the second whorl of petals three or four members instead of two. Since this removal takes place in a direction away from a transverse line connecting the sepals the result is to leave the original petals in nearly their normal position, and to bring the added petals into a median position. That this second whorl does not consist typically of four petals in these cases is shown by the fact that the space opposite the intercalated petals is left vacant, whereas a whorl of four members should be equally distributed. According as one or two petals have been removed from the inner whorl to the middle whorl, one or two petals are added to those remaining in the inner whorl and these added petals are again placed near a transverse line connecting the sepals, but on the same side of this line.

In a third case, one, fig. 9, or both petals of the second dimerous whorl have become two by dedoublement. In that case the four petals of the inner whorl occupy as nearly as may be their original positions and one, fig. 9, or two petals are added to their number and then occupy the interval created by the separation of petals of the second whorl into two through dedoublement. In this case the addition is made precisely in line with the transverse position occupied by the sepals. The three variations from the type just described are

all frequent enough to be considered characteristic of this plant. The first variation is the most common, the second, next, the third, least frequent.

A unique case is illustrated in fig. 10. Here the oblique position of the sepals is not considered of moment owing to the normal position shown by the first set of petals; it is illustrated, however, because it is the only *good* case of oblique position of sepals found during these investigations. The second set of petals consists of four members. It would be easy to say that dedoublement had taken place but then in that case two of the petals of the inner whorl should not take up a position so decidedly transverse to that shown by the first whorl of petals. Again the interpretation of the inner whorl as a dimerous whorl is excluded by the third petal which seems to make an effort to continue the greater number of members usually shown by this whorl. If this case were not unique, it would spoil all value of the previous observations.

As it is, a number of interesting facts seem to have been brought to light, not usually considered in the study of phyllotactic arrangements shown by flowers. The first of these is that new members are not added indifferently to those already existing, but follow certain laws or tendencies. The most general of these, in the blood-root, is that added members have a tendency toward placing themselves in a position more or less in line with the sepals, obliquely so in the first set of variations described, on one side of this line in the second set, and exactly in line in the third set. These positions are more or less approximately that which a new dimerous whorl would take if added to those already existing. A second fact is that succeeding whorls attempt to accommodate themselves to abnormal conditions shown by previous whorls. This finds its best expression in the intercalation of new petals in succeeding whorls in order to fill up the interval caused, apparently by dedoublement, in the preceding whorl. A third fact is that these changes in the arrangement of the petals as here instanced have taken place without producing any effect upon the position of the leaves of the pistil, and hence have not the value of newly added whorls. It is difficult to decide how far dedoublement can account for these phenomena, where its application has been quoted, or even omitted.

The slightly oblique position shown occasionally by the pistil leaves, is due largely to crowding during their later development in the bud.

The buds should be studied at as early a stage as possible. Fig. 11 represents a plant, as it was seen on Feb. 15th, during a very cold winter. The protecting scales have been removed and the larger leaf forcibly expanded. Fig. 12 shows the petals and stamens, partly enclosed by one sepal, the other having been cut away. Fig. 13 gives a slightly magnified view of the pistil at this period. It is evident from the size already attained by the organs, that flower buds should be studied for phyllotactic purposes during the summer previous to their flowering season.

Trillium sessile.— In the spring of 1882 a four leaved Trillium was found which illustrated admirably the attempt of succeeding whorls to continue or accommodate themselves to the abnormal conditions presented by previous whorls. This case is illustrated by fig. 14; the letters serve to designate the flower members but have no other significance. In the normal development of this plant there should be three sepals and three petals, in decussating whorls. The outer set of floral envelopes, marked *a*, *b*, *c*, should have been sepals, and the inner set, marked *d*, *e*, *f*, should have been petals. Instead of that, sepal *e* occupies the position of a petal, and together with sepal *c* attempts to attach itself to the whorl of four leaves as though it were an independent dimerous whorl of sepals. This attempt, however, is spoiled by sepal *a* in its usual position, but as if to maintain at least the semblance of a dimerous whorl, that part of petal *f* which lies next to sepal *c* is colored greenish like a sepal, and thus *c* and half of *f* are opposed to *a* and *e*. Further *b*, which should be a sepal, is developed as a petal, and only two of the first whorl of stamens are in existence, *b* and *c*, the third *a* being entirely absent. The second whorl of stamens and the leaves present the normal conditions. If now this case be considered as the attempt of a trimerous plant to accommodate itself to the dimerous conditions presented by the leaves, then the absence of a stamen in the first whorl can be explained. The dimerous whorl of leaves *A*, *A*, is succeeded in decussating order by a second similar whorl *B*, *B*; and this in a similar way by *a*, *e* and *c* with the adjacent part of *f*, all acting together as a simple dimerous whorl, decussating with *B*, *B*, and all having a greenish color. With this in turn the purple petals *d* and *b* are found decussating, occupying a position almost directly in line with the leaves, *B*, *B*. The trimerous character of the plant

retains sufficient power to keep half of *f* deep purple as a petal should be. Decussating with *d* and *b* are the stamens *b* and *c* as a dimerous whorl. The stamen *a* which is absent, would be out of place in a dimerous whorl. The typical trimerous character is first again fully developed in the second set of stamens and is retained by the pistil leaves.

The appearance of this plant in early winter is shown by fig. 16. The seedling always starts to grow near the surface of the ground, and pushes its way laterally under the soil. Fresh roots start each year from the anterior growths of the stem, the older roots decay, and when with age the anterior roots begin to wrinkle and hence to contract, they have a tendency to pull the growing end of the Trillium deeper and deeper into the soil. In a similar way the roots of *Symplocarpus fœtidus* and *Arisæma triphyllum* draw the stems or corms of these plants deeper and deeper into the soil, but in the latter cases directly downwards. Fig. 15 shows the leaves and flower bud of fig. 16, with the protecting scales removed. At the base of the flowering stem *c* is seen a bud *f*, which represents the flowering stem of the season following *c*. The rootstock has been wrenched so as to show better the fact that the flowering stems and hence their scars *d*, *c*, *a*, and others are placed alternately on the right and on the left side of the rootstock.

Jeffersonia diphylla.—Gray has given a diagram for the flowers of the twin-leaf which makes them tetramerous, with the exception of the pistil which has only one leaf. (Genera Fl. Amer. Bor. Ill., vol. i, 34). In southwestern Ohio, where this plant is very abundant, the calyx almost always has five members, arranged rather on the plan of a spiral than that of a whorl. Four sepals were a comparatively rare exception. Two whorls of petals and two whorls of stamens were tetramerous in either case, whether the sepals were four or five in number. Typical Berberidaceæ possess an equal number of members in each of the whorls of the sepals, petals, and stamens. Perhaps it was the attempt to correlate the diagram of Jeffersonia with those of typical Berberidaceæ which led to the selection of the less frequent forms with a tetramerous calyx, as representing the typical Jeffersonia. The rarity of tetramerous forms in the calyx, and the frequency of flowers with five sepals however, makes it plausible that the five sepaled calyx still points to the original pentamerous spiral

character of these whorls, which at present is no longer shown by the petals and stamens. In fig. 17, the figure given by Gray is repeated with certain variations, in order to call attention to the peculiar position of the single pistil-leaf. This leaf should fall opposite one of the stamens of the outer whorl. As a matter of fact, however, it is opposed to a stamen belonging to the inner whorl in the flowers examined.

Fig. 18 represents a subterranean bud of the twin-leaf, collected Feb. 15th with a few scales removed in order to show, at *a*, the bud from which is to develop the flowering bud two years hence. Fig. 19 shows the same bud after the removal of all the scales, in order to show the flower bud of the next season, surrounded by the leaves of the same season. Fig. 20 presents a view of this flower bud after the petals have been forcibly spread apart, showing the petals and stamens.

Rhamnus lanceolatus.—The branches of many shrubs near Dayton, Ohio, showed the leaf arrangement indicated in fig. 21, which may be briefly characterized as consisting of decussating dimerous whorls of leaves, in which the leaves, apparently belonging to the same node, are not strictly opposite to each other, but are separated by a more or less pronounced interval. This interval is in most cases not large enough to altogether destroy the effect of decussating whorls as just described. The same plants often show a typical two-fifths phyllotaxy. As a rule species of Rhamnus are described as possessing an alternate arrangement of leaves.

Fraxinus.—A twig collected at Granville, Ohio, is represented by fig. 22, but only one-fourth of its natural size. Here a branch has divided dichotomously, between the nodes *A* and *B*, but that the dichotomous character was already developed at a much earlier period is shown by the development of four leaves at the node *A*; the median two leaves should have met at the centre of the compound stem at this locality, but they have been crowded towards the exterior so that both appear in the figure here presented. That the dichotomous character was developed at an even earlier stage is shown by the position of the upper scales of the winter bud. The effect of this irregularity (best seen at *A*, upon the succeeding nodes *B*, and *C*,) is to increase the interval between the leaves belonging to the same node, already shown at *A*. This interval again diminishes at the node *D*, and ceases at node *E* in one branch and at node *F* (not figured) in the

other. The lateral branches are all normal. This case is quite typical for phenomena as shown by dichotomously branching abnormal stems with opposite leaves. The small letters indicate that the leaves are situated on the side of the branch away from the observer, and these leaves are indicated by dotted contours in the figures.

Heidelberg, Germany.

A study of some anatomical characters of North American Gramineæ. I.

THEO. HOLM.

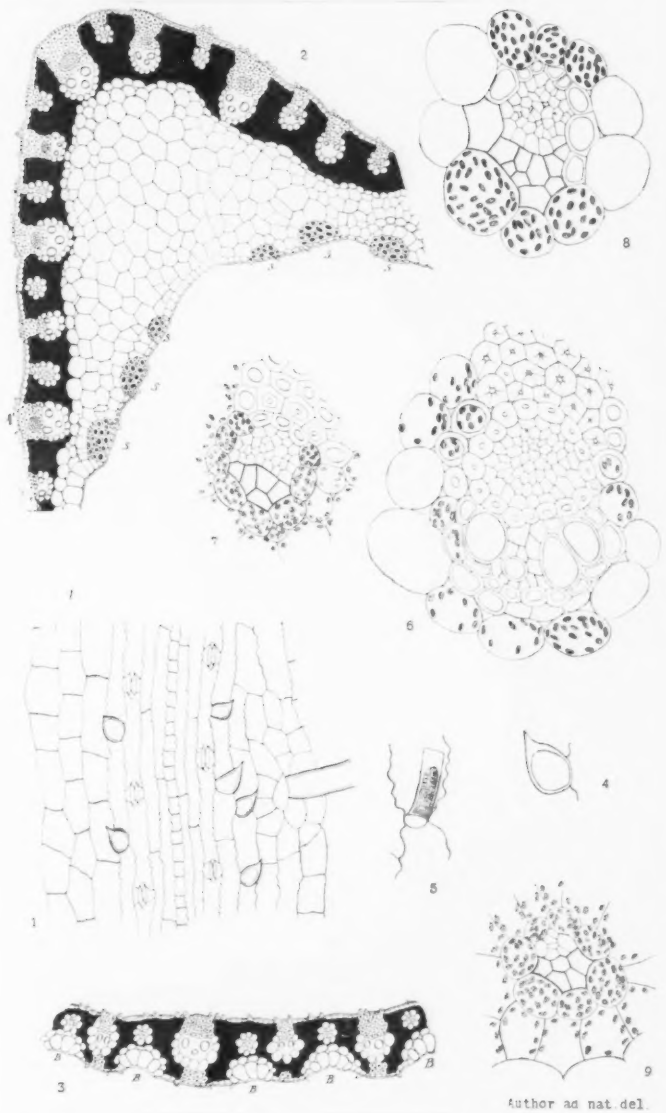
The genus Uniola.

(WITH PLATE XV.)

In the year 1810, when Brisseau-Mirbel said:[1] "Le seul moyen de perfectionner les familles naturelles, est à joindre à l'étude des caractères botaniques, celle de tous les faits relatifs à l'anatomie et à la physiologie," he hardly thought of the important change that would come about in systematic botany. The rapid increase in the number of species known made it evident that botanists must not content themselves with the mere external characters, but that others should be sought. Later appeared a series of researches especially by French and German authors, wherein an attempt was made to give anatomical diagnoses to a number of species; most successfully by Duval-Jouve, Radlkofer and Vesque. The importance of studies of that kind was very clear; they not only furnished additional and often even more reliable systematic characters, but they extended the study of anatomy into wider fields than ever before, until anatomy has become one of the most important modern lines of botanical science.

And the study of internal structure gave also a most striking illustration of the physiological life; it became easy to infer from the structure the conditions under which the plant had lived, whether in dry or moist localities, exposed to the sun or in deep shade, etc. Anatomy also rendered great help in the discrimination of species, as shown for instance by

[1] Sur l'anatomie et la physiologie des plantes de la famille des Labiées. (Ann. du Muséum d'Hist. Nat. vol. xv.)



author ad nat. del.

HOLM on UNIOLA

Vesque,[2] who proved that the anatomical characters are much more distinct and precise than the organographical ones, and that species of *Capparideæ* may be easily distinguished merely by the structure of the leaves.

To speak in particular of the *Gramineæ*, we have several works of the greatest importance upon this subject. Duval-Jouve described[3] species of Agropyrum merely by the structure of the rhizomes, culms and leaves, and he stated in his "Histotaxie des feuilles de Graminées"[4] the principal modes of arrangement of the tissues in the leaves of this family in relation to the surrounding medium.

Furthermore Hackel in his "Monographia Festucarum Europæarum" (1882), has shown the importance of the leaf-structure as to the specific differences in Festuca. The same author has also observed that most of the species of the Andropogoneæ[5] show very good anatomical characters; and finally Güntz[6] has made a special study of the leaf-structure.

These studies are, however, not only of a purely scientific, but also of a practical value, and it is easy to understand, that they must be a great help, when it is necessary to identify specimens without flowers. But that this may be done it will be necessary to know the structure of a large number of species. That such determination is possible to a certain extent will be evident if we simply recall the numerous differences in the form of the rhizomes, the sheath ligule and blade of the leaves, the vernation, etc., which, combined with anatomical characters, seem likely to give very reliable results. A few attempts have already been made in the most practical manner to identify Grasses at a stage where the flowers are not developed, for instance by Samsöe Lund[7] and Beal.[8]

We now proceed to give some anatomical sketches of our native grasses, making the beginning with the genus *Uniola*, of which five species are enumerated from this country, namely:

[2] Essai d'une monographie anatomique et descriptive de la tribu des Capparées. (Ann. d. Sc. Nat. Botanique, ser. 6, vol. xiii, 1882).

[3] Étude anatomique de quelques Graminées, et en particulier des Agropyrum de l'Hérault. (Mém. d. l'Acad. d. Montpellier, vol. vii, 1870).

[4] Ann. d. Sc. Nat. Botanique, ser. 6, vol. i. 1875.

[5] A. et C. De Candolle: Monographia Phanerog. Prodromi; vol. vi, 1889.

[6] H. E. M. Guentz: Untersuchungen ueber die anatomische Structur der Gramineenblaetter, etc. Inaug.-Dissert. Leipzig, 1886.

[7] Vejledning til at kjende Græsser i blomsterlös Tilstand. Kjöbenhavn, 1882.

[8] W. J. Beal: Grasses of North America for farmers and students, 1887.

U. latifolia Michx., *U. gracilis* Michx., *U. nitida* Baldw., *U. paniculata* L. and *U. Palmeri* Vasey.

Uniola latifolia Michx.—A series of anatomical sections have been figured on plate xv. These sections have been taken from the middle part of a completely developed leaf.

As regards the structure of the epidermis of the superior face (fig. 1), this does not show anything of particular interest. The cells of which it consists are of different size and shape, forming longitudinal lines in the blade, and the differences depend upon situation.

The large bulliform cells[9] lie in broad lines, covering the green parenchyma between the large nerves, and they form about six rows of rectangular, uncolored cells. Sometimes and especially toward the midrib they are interrupted by prominent and roundish groups of cells, surrounding the base of long, stiff and pointed unicellular hairs. Bordering on each side of these strips of bulliform cells there are some rows of smaller, rectangular cells, the side-walls of which are more or less undulated. They cover a small part of the green parenchyma. The stomata are to be observed here, and they form only a single line on each side of the groups of bulliform cells, while the other lines possess numerous short, very thick-walled and pointed expansions. In alternation with these thorn-shaped expansions are also to be seen short, unicellular, slightly curved and obtuse hairs. Besides these rows of epidermis cells there are still a few, from one to five, rows which cover the stereome. These consist of very short and narrow cells, the walls of which are strongly thickened.

Comparing the epidermis of the superior face, described above, with that of the inferior face, we see the following differences. The bulliform cells are entirely absent, as well as the long hairs; the short hairs are on the contrary also to be observed here together with the thorn-shaped expansions, which are still more numerous on this face. The stomata show the same distribution and number as mentioned before.

We now examine a transverse section of the whole blade, which, compared with similar sections of the other species of the genus, shows differences worthy to be considered as specific. Figs. 2 and 3 represent respectively sections from the middle part of the blade and a small lateral part, adjoining this. The median nerve (fig. 2) does not occupy the whole

[9] Duval-Jouve: Histotaxie des feuilles de Graminées l. c. p. 316.

carene, but merely forms a centre for the entire system of the mestome. It is the strongest one, containing the farthest developed leptome and hadrome, and is supported by the largest group of stereome, but does not, however, connect the superior face of the blade with the inferior. The carene itself consists of two groups of mestome-bundles, one on each side of the median line, and these are all separated from the superior epidermis by an immense tissue of uncolored parenchyma. The uncolored parenchyma preponderates then in this part of the blade and is partly separated from the superior epidermis by six relatively strong bundles of stereome. In the lateral parts of the blade it is restricted to a single stratum inside the rows of bulliform cells.

As to the mestome bundles, there are in this species about seventy on each side of the median nerve, and they represent three different degrees of development. The largest (fig. 6) are characterized by having a layer of very thick-walled parenchyma between the leptome and the hadrome, completely enclosing the first, and both the leptome and hadrome are here strongly developed; furthermore by being supported by two large groups of stereome, above and below, just excepting the bundles of the carene, where no stereome is in connection with the superior face of the mestome. The second degree of development (fig. 8) shows smaller bundles of stereome above and below, and the leptome is not separated from the hadrome by any layer of thick-walled parenchyma; there is merely a semicircular layer of thick-walled parenchyma bordering on the leptome side. Fig. 9 illustrates one of the smallest mestome bundles, completely imbedded in the mesophyll and without any groups of stereome; there is no thick-walled parenchyma to be observed here within the proper parenchyma sheath.

As regards now the arrangement of these three different forms of mestome bundles, this is as follows: The two larger are constantly situated on each side of the groups of bulliform cells, while the smallest, those of third degree, are restricted to a position just between the bulliform cells and the inferior face of the blade. It must be remarked, however, that this arrangement does not include the bundles of the carene, for the reasons mentioned above. As to the number of these three forms, the smallest ones are the most numerous in the whole blade. It may be expressed diagramatically as follows:

$A^*-C-B-C-A-C-B-C-A^1-C^1-B^1-C^2-B^2-C^3-A^2$, where A indicates the largest bundles of mestome, the median being A^*; B shows those of second and C those of third degree. A^1 corresponds then to the strong bundle in fig. 2, marked in the same manner, and it is situated below the outermost group of stereome in the figure, separated from this by the uncolored parenchyma. C^1 is the first bundle situated between the first group of bulliform cells and the inferior epidermis. The disposition of the groups of bulliform cells may be seen in the same formula, namely, between A^1 and B^1, B^1 and B^2, B^2 and A^2, just above the C's, beginning at C^1. This formula may not be strictly constant, but it gives, however, the general features concerning the relative number and arrangement of the mestome bundles.

Besides the proper parenchyma sheath of green or sometimes uncolored cells, never wanting in the mestome-bundles of the Gramineæ, some of these bundles show the presence of another sheath or at least a layer of thick-walled parenchyma inside this. A distinct thick-walled sheath is shown in fig. 6, enclosing the leptome, and we are able to trace it also in the small bundles (fig. 8), though not in the smallest ones (fig. 9). Schwendener[10] has called attention to the presence of this parenchyma, which in several instances looks very much like what the same author has called a "mestome-sheath." But in Uniola latifolia there is no mestome-sheath; for the reaction with concentrated sulphuric acid proved that the thick-walled cells, whether they form a closed sheath or not, merely belong to the mestome parenchyma. Furthermore, if it had been a mestome-sheath it would also have been present in the smallest bundles. The proper parenchyma sheath showed in some instances (fig. 7), a thickening of the cell-walls, especially in the cells which border on the leptome side.

Now, concerning the arrangement of the stereome-bundles, we have already seen in the description of the mestome that the arrangement is nearly identical. There is one group above and below the two largest mestome-bundles, but none at the smallest ones, and there are merely six isolated groups on the superior face of the carene, which are not in contact with the mestome. Besides there is also one rather strong group in each of the outermost parts of the blade, the margins.

[10] S. Schwendener; Die Mestomscheiden der Gramineenblaetter. (Sitzungsberichte d. wiss. Acad. Berlin, 1890).

The mesophyll in this species forms in a transverse section an interrupted line, being in immediate contact with the epidermis of the inferior face, except where it is interrupted by the large mestome-bundle of first or second degree. It is on the contrary almost entirely separated from the superior epidermis by the stereome and the uncolored parenchyma under the bulliform cells. The mesophyll showed a rather firm structure without any lacunes.

These are the general features of the anatomical structure of the leaf of Uniola latifolia, and it will be shown in a following paper that these characters as compared with the corresponding ones in the other species are of truly specific rank.

U. S. National Museum, Washington, D. C.

EXPLANATION OF PLATE XV. — *Sections of the leaf of Uniola latifolia.* Fig. 1. Epidermis of the superior face, ×240. Fig. 2. Transverse section through the middle part of the blade, the carene. The black part of the figure represents the mesophyll, which borders on the large uncolored tissue of parenchyma. The mestome bundles with their parenchyma sheaths and groups of stereome are to be seen in the mesophyll. Six rather large bundles of stereome (*S*) are to be seen on the superior face, the concave part of the carene. ×75. Fig. 3. Transverse section through a part of the blade, next to that figured in fig. 2. Five groups of the large bulliform cells are to be seen at *B*. ×75. Fig. 4. Thorn-shaped expansion from the superior face, ×320. Fig. 5. Hair from the inferior face, ×320. Fig. 6. Transverse section of one of the largest mestome bundles of the carene, showing the partly green parenchyma sheath, the leptome above and the hadrome below. The leptome is surrounded by a sheath of very thick-walled mestome-parenchyma bordering on a group of stereome. ×560. Fig. 7. Transverse section of a small mestome bundle, that next to the midrib. Three cells of the green parenchyma sheath show a distinct thickening of the cell wall. A group of stereome borders on the leptome side. ×560. Fig. 8. Transverse section of a small mestome bundle from one of the lateral parts of the blade. There is a horseshoe-shaped sheath of thick-walled parenchyma on the leptome side, and the proper parenchyma sheath shows four uncolored cells, while the other ones contain chlorophyll. ×560. Fig. 9. Transverse section of a small mestome bundle, not far from that figured in fig. 8. The parenchyma sheath is perfectly green, and there is no thick-walled parenchyma inside this. ×560.

On the organization of the fossil plants of the Coal-measures.[1]

DAVID WHITE.

[The following review contains so much of anatomical importance that we give it this more conspicuous place.— EDS.]

The observations recorded in these three memoirs, while confined chiefly to types, most of which have been treated more or less in the preceding parts, are hardly less remarkable for the information they bring to bear on the mode of the formation of the medulla and the development of exogenous growth in certain Carboniferous cryptogams, than for the proof they furnish of the existence of an exogenous growth among the Carboniferous ferns.

Part XV throws new light on the structure of the rhizomes and petioles belonging to Corda's genera Zygopteris and Anachoropteris, as recognized by Renault, Stenzel, and others, which Williamson shows to be generically equivalent. For these he prefers the name *Rachiopteris* proposed by himself in 1874 (Pt. VI, p. 677) "for a considerable number of these objects which appeared to be either rhizomes or petioles of ferns," for the reason that an examination of the structure of living ferns, classified by their fructification, shows that "no classification of fossil ferns based solely on the characters revealed in transverse sections of their petiolar bundles can be of value." Neither Prof. Williamson nor several other recent authors, seems to be aware of the coincident fact that Dawson in 1861 (Q. J. G. S. L., xviii, p. 323), with equal appropriateness, proposed the new genus *Rhachiopteris* "to include such Devonian stipes as indicate the existence of distinct species of ferns, of which the fronds have perished." Schimper does not seem to have known of Dawson's genus when he established his *Rhacopteris* (Traité, I, 1869, p. 481), based on the character of the fronds. Incognizance of these facts and the too common mis-spelling of the generic names have caused much confusion in the nomenclature.

To a fine species, from the Halifax deposits, related to Renault's *Anachoropteris Decaisnii*, Williamson gives the

[1] WILLIAMSON, W. C.—On the organization of the fossil plants of the Coal-measures. Phil. Trans. Roy. Soc. London. Part XV, vol. 180 (1889) B. pp. 155–168, pl. i–iv. Part xvi, l. c., pp. 195–214, pl. v–viii. Part xvii, op. cit., vol. 181 (1890) B. pp. 89–106, pl. xii–xv.

name *Rachiopteris Grayii*, while the section of a hairy branching stem or rhizome, also from Halifax, resembling in many respects the young branches of living Marsileæ, is named *R. hirsuta*. Two roots, from Halifax and Oldham, showing tructure minutely, are called *Rhizonium verticillatum* and *R. reticulatum;* and a third, equally remarkable in structure, whose features resemble those seen in the cortex of *Asterophyllites Williamsonis*, is named *R. lacunosum*. The examination of new specimens of *Calamostachys Binneyana* has enabled the author to fill two gaps in the knowledge of the structure of that interesting form of strobilus, viz. the distribution of the vascular bundles of the central axis, and the peripheral termination of the sporangiophores. Sections of a fertile strobilus through the latter show a thickened distal end, occupied by clusters of tracheids concentrated in the region where each sporangium is organically attached, showing "that these peripheral terminations of the sporangiophores approach even nearer than they were previously known to do to those of the living Equisetum, in corresponding parts of which similar clusters of tracheids exist."

Part XVI is devoted to studies of the mode of branching, the formation of the medulla, and the method of exogenous growth as seen in a number of Lepidodendra, several of which are here first described. The author considers the ordinary mode of branching in this genus to have been dichotomous, with a perfect dichotomy of the medullary vascular cylinder, but that only a segment was cut off from that vascular bundle when the branch was of a special kind, "characterized by an arrested development," such as is represented by the tubercles of *Halonia*, or the scars of *Ulodendron* in which the arrested branches supported Lepidostrobi, both of the latter genera being only "conditions" of various Lepidodendroid genera.

He finds that the germs for the gradual formation of a medulla in the center of a vascular bundle which previously contained no traces of cellular structure were furnished by the procambium from which, in the youngest twigs, the entire bundle originated. The first one or two medullary cells, formed in the centre of the bundle of tracheids, increased by the ordinary meristemic process of enlargement and fission. The internal tension produced by the enlargement of the med-

ullary cellular expansion caused the vessels of the vascular bundle to form a ring increasing in size, the number of vessels also increasing correspondingly and changing their respective positions. This meristemic process is repeated "until the medulla and its surrounding vascular ring attain to their ultimate magnitude—a condition which was probably coincident with the first appearance of the more external exogenous zone." It is probable that the new vessels are produced centrifugally, on the cortical side of the vascular cylinder, though it is possible that some of the young medullary cells assumed a procambial form and were converted into vessels. In any case he considers that the enlargement of the medullary vascular cylinder is mainly, if not wholly, effected "through the internal tension occasioned by the subsequent multiplications and expansions of the medullary cells—a condition that has no existence among the exogenously-grown trees now living." He regards the occurrence of an exogenous growth at some time in the development of all the Carboniferous Lepidodendra as more than probable.

The existence of an exogenous growth among the arborescent Lycopods, Gymnosperms, and Calamarias has long been known. Part XVII of these memoirs has the important office of making known the existence of an exogenous development among the Carboniferous ferns. The anticipation expressed by the author, in Part IV, that *Dictyoxylon* (*Lyginodendron*) *Oldhamium*, there described as belonging to the paleozoic Proto-gymnosperms, might be identical with the petioles described in the same memoir as *Edraxylon*, and later (Part VI) as *Rachiopteris aspera*, is now confirmed, and the two are conclusively proved to be trunk and petiole of the same plant. The study is thorough; the steps in the growth of the petiole from the trunk are observed with the accuracy and minuteness of detail characteristic of the author's former memoirs. The pairs of vascular bundles so characteristic and conspicuous in the middle cortex of *L. Oldhamium* are shown to pass outwards through the outward cortex and become the tracheal bundles of the petioles of *R. aspera*. The clusters of tracheæ, in the small stems, which at first formed one united axial cluster, are separated, the space thus produced at the center being occupied by a steadily expanding parenchymatous medulla. This process is accompanied by a corresponding enormous increase in the number of the vascu-

lar laminæ, the inner extremities of which, though commencing their growth at different periods of life, all start from the medullary border of the vascular zone and extend to the periphery. Among the numerous specimens examined the number of laminæ varied from 44 in a small specimen to 1120 similarly arranged laminæ in a larger one. The transition between the petiolar and trunk structures was not only observed in all stages from many fragments, but specimens were studied in which stem and petiole are organically united, demonstrating not merely that *Lyginodendron Oldhamium* is a true fern, probably belonging to the Sphenopterids, but also that the stems of some, at least, of the Carboniferous ferns "developed their xylem or vascular structure exogenously through the instrumentality of a meristemic zone of the innermost cortex, which practically must be regarded as a cambium layer."

Additional observations on the growth of *Heterangium Grievii* are contributed, without establishing its true affinities, though it seems likely eventually to prove to be a fern. The discovery of the vegetative organs of *Bowmanites (Volkmannia) Dawsoni* and the study of their structure shows an organization generically identical with that of the Asterophyllites described by the author in a former memoir, and the plant described by Renault as *Sphenophyllum Stephanense*. The triangular central vascular axis is the most conspicuous character in the three types. Bowmanites, though it can be regarded as generically identical with the Sphenophylla whose fruits have been definitely correlated, is most strongly allied to the Sphenophylloid type. Williamson calls attention to the fact that evidence is being obtained of the existence of Carboniferous plants whose branches bore both Asterophyllitean and Sphenophylloid leaves (a view supported by Stur's researches among the Schatzlar Calamariæ), and that Sphenophyllum and some forms of Asterophyllites should be united in the same genus. All these types, however, he regards as belonging to the great family Calamariæ, of which Equisetum is "a poor, feeble and degraded member," rather than the central type.

Washington, D. C.

On the relation between insects and the forms and character of flowers.

THOMAS MEEHAN.

Surely all must concede that those who are industriously collecting and recording facts in relation to the visits of insects to flowers are engaged in a work of great value to science. To my mind one of the weaknesses of these observers is to attach too much importance to their work. In the enthusiasm of useful discovery, it becomes difficult to believe that the facts noted by other observers can have a value equal to our own, and we must deal leniently with the friends whose weakness induces them to belittle or ignore the work of others in parallel lines. It will do no harm, while so much is being claimed for the influence of visiting insects on the form and general behavior of flowers, to note a few propositions which have been presented and proven during the past few years, and in which I think my own work has had a place, which surely show that insects are not the all important factors in many given results credited to them.

1. Many changes in the forms of flowers are attributed to the insect's touch, and it is claimed that modification has slowly proceeded through the ages responsive to these insect habits; but it is surely not denied, at this day, that change does not occur by slow modification, but by leaps, and often by leaps of a gigantic kind. Insects can do nothing here.

2. It has been shown that in the earlier stages of fertilization there is no reason why a flower may not be indifferently of either sex, and that the final determination of this matter is a question of nutrition, with which an insect can have little to do.

3. There is no question that a flower proterandrous in one district or season may be proterogynous in another — that it is wholly a matter of meteorological influence, in which an insect has no place.

4. Fertility in plants is not wholly a matter of pollination. Some plants are barren though the pollen tubes can be traced to the ovules, and myriads of fruit resulting from perfect fertilization fall in an early stage. Nutrition is of as

much importance as fertilization by the pollen in an early stage[1] in securing ultimate fruit.

5. The floral parts are modified leaves — modified by a process that lessens their vital power — and color in these floral parts is an attribute of weakening vital power, having no relation to the visits of insects.

6. Plants wholly dependent on insects for fertilization are all perennials. An innumerable number of the flowers of these plants fall unfertilized, and but for their being perennials, many species so dependent would have long since disappeared.

7. All annuals, though in some cases so arranged that cross-fertilization may occur, can self-fertilize when cross-fertilization fails. In fact annuals are in a general sense self-fertilizers. In almost all cases annuals have every flower fertile.

8. Flowers do not abhor own-pollen, as the proposition once enthusiastically ran. No flowers are so truly fertile as those of the cleistogene class, while the nearly allied class of plants which fertilize before the corolla expands are also certainly fertile. The list in these two classes has grown so large as to render the proposition cited untenable.

9. It is conceded now that variety or variation is an essential condition in the order of things, — and that there is no more reason why special forms or colors in flowers should be made dependent on the accident of an insect's visit, than are forms and colors of minerals. The forms and colors of flowers must have had an extensive range had not an insect appeared on the stage.

We must not forget that what we call the kingdom of nature is a vast organization in which a great number of smaller and inferior powers are working apparently independently, but actually in co-operation or accord with the greater ones. No one phenomenon can be fairly placed to the credit of any one direct cause. The forgetfulness of this fact leads to many an error in our theoretical deductions. At any rate the unchallenged propositions I have enumerated, show how many things have to be considered before we accept the wide generalizations presented by those who tell us of the relation of insects to the forms and characters of flowers.

Germantown, Phila.

[1] This proposition is commended to the author of the note on Cephalanthus, at p. 66 of this volume.

BRIEFER ARTICLES.

A suggestion on the proper terminology of the spermaphytic flower. — Faults in botanical terminology are, as in all other branches of science, very numerous. The more striking ones may perhaps be classed under a two-fold grouping — those which represent actual differences of opinions among authorities or different methods of naming the same phenomenon and those which indicate the *vis inertiæ* of the science on account of which universally abandoned notions are perpetuated by the retaining of the unmeaning or misleading words which were applied when erroneous ideas regarding anatomy, development and homologies were the only ones known to botanists. Of the first mentioned group the words Phanerogam or Gymnosperm are good examples. No one supposes that the Phanerogams are really the plants in which fertilization is distinct — as was the notion of Linnaeus. The word to-day may be applied to the group of plants which produce embryos and pollen-tubes — the Embryophyta Siphonogama of Engler, or it may be defined as the group which produces seeds and suspensors, or as the group in which one may distinguish the three embryonic layers of Hanstein and secondary endosperm. It makes no difference; the word is good enough if one defines it correctly. Whether one says Anthophyte, Spermaphyte, Seed Plant or Phanerogam is unimportant. So whether one defines the Gymnosperms as seed-plants with apical cells as Van Tieghem defines them, as Archispermous flowering-plants after Strasburger, as polyembryonic seed-plants, as seed-plants with suppressed secondary endosperm, as flowering plants with uncompressed floral axes; whether one accepts the view of Eichler regarding the homology of the cone or that of Baillon is of no importance. In any case the words are correct enough and express very well what one wishes to express when one uses them.

The other group of erroneous terms can not be dismissed so lightly. One of the most confusing places for the novice in botany is that part of the ordinary text-book which treats of the flower. The old and mistaken notion that flowers contain male and female organs took such hold of the authors on botany that, to this day, although it is about fifty years since the idea was abandoned, one can find nothing but confusion in the terms which are applied to the various phases and parts of flowers. Gray[1] speaks of hermaphrodite, unisexual, male and female flowers; Sachs of hermaphrodite flowers, of sexual organs — meaning stamens and pistils[2]; Gœbel of unisexual flowers and

[1] Structural Botany p. 191.

[2] Physiology of Plants, Eng. tran. p. 789 and elsewhere.

hermaphroditism, of male and female flowers[3]; Bessey of the female flower of Gymnosperms[4]; Luerssen of the male and female organs, of male and female flowers (die Geschlechtsorgane, männliche Blüthe, weibliche Blüthe, etc.)[5]; and one can hardly find an author of note who does not thus perpetuate in his terminology notions which he must certainly have abandoned and desires to guard others against adopting.

Now in this case there seems to be no excuse for such looseness. If biology is to be an exact science it should use its terms as the chemist or physician does. Acids must not be called bases, magnetism must not be called heat, electricity must not be called thermodynamics. Let it be remembered that reproductive cells are of two kinds, those formed by division of an existing plant-body, namely spores, and those formed by fusion of gametes, namely eggs. A plant which produces pollen-grains, embryo-sacs, conidia or any kind of spore is a spore-bearing plant or sporophyte (in the widest sense); a plant which produces gametes (whether they be isogametes as in *Ulothrix*, *Mucor*, *Syncephalis*, or spermatozoids and eggs—both or either) is a gamete-producing plant or gametophyte. We may then use our terms correctly as follows:

Gametophyte group.	*Sporophyte group.*
Hermaphrodite.	Monoclinous, diclinous.
Unisexual, bisexual.	Monoecious, dioecious.
Male, female.	Staminate, pistillate.
Spermatozoid, egg.	Microspore, macrospore.
Fertilised egg.	Macrosporophyll, microsporophyll.
etc.	etc.

We may speak of hermaphrodite, unisexual, male prothallia of ferns, if we like, but we should certainly say monoclinous, monoecious, microsporophyllous flowers. The general adoption of some uniformity in the applying of names to flowers and parts of flowers would not only make all discussions of them clearer but would not do learners the injustice of forcing upon them the very ideas which it is deemed important they should not get.—Conway MacMillan, *Minneapolis, Minn.*

Curious case of germination in Citrus decumana.—I received a few days ago from Prof. Le Baron R. Briggs, of Harvard University, half of a fruit of *Citrus decumana* on the cut surface of which was a seed which had begun to germinate. The hypocotyl was, at the time, a

[3]Outlines of Classification and Special Morphology, Eng. tran. p. 347.

[4]Botany, 5th edition, p. 397.

[5]Systematische Botanik ii, 193.

quarter of an inch long, and the well formed cotyledons had already separated, showing the plumule which had just begun to expand. What is to be noted as curious in this case, is the fact that the seed had germinated in the intact fruit, and the cotyledons and plumule were dark-green in color. Normal germination of seeds under such circumstances is so rare that one naturally is lead to suspect that some mischievous person had inserted a germinating seed into the fruit after it had been cut open. This possibility is excluded by the positive statement of Prof. Briggs, that the fruit was brought to his table perfectly intact, that he saw it cut open, and at once noticed the green seedling which was in the center of the fruit, just where the cut was made, and escaped injury except that a small part of one of the cotyledons was cut away by the knife. The testimony is so positive that suspicion of deception is excluded, and we must believe that the seed actually germinated and bore green cotyledons and plumule while enclosed in the sound fruit.—W. G. FARLOW, *Cambridge, Mass.*

Coursetia axillaris, n. sp.—Shrub or small tree (?), the younger parts pubescent : leaves small, odd-pinnate; leaflets 3 to 5 pairs, reticulated, almost glabrous above, somewhat pubescent below (as is also the rhachis), 3 to 8 mm. long, obtuse, the lower pair orbicular, the upper pairs obovate : flowers axillary, on peduncles 4 to 10 mm. long : calyx pubescent, 4 mm. long, with 5 broad equal teeth (the 2 upper ones high connate): petals about equal in length; vexillum very broad (12 mm.) and reflexed; wings oblong: vexillary stamen free; the others equal: style slender, very hairy above the middle: ovary 2 to 8-seeded: pod 2-valved, glabrous, 3.5 cm. long, with lobed margins and on a broad stipe.—San Diego, Texas, April, 1891, (*G. C. Nealley*, 16). This plant is interesting as being an intermediate form between two closely related genera, Coursetia and Sabinea. While the general characters are those of Coursetia, the inflorescence is that of Sabinea. In habit and pods it is nearest C. glandulosa of Arizona and Mexico.—JOHN M. COULTER, *Crawfordsville, Ind.*

EDITORIAL.

A MOVEMENT has begun in Indiana, which may lead to good results. A teacher's "reading-circle" has been organized for some years, containing, it is claimed, 30,000 members. Different subjects are selected each year, and an executive committee directs the proper books to be read. It has been found very profitable to publishers to secure the

sale of 30,000 copies of any book they own, and to furnish with the book an "outline of study." It is not our province to speak in general of the books used, but since botany has been made one of the subjects of the present year, we may be justified in commenting upon the character of the work proposed. We are free to say that if the whole range of botanical literature had been searched, no more unsuitable book could have been found to give these teachers any conception of modern botany.

IT WAS with a feeling of curiosity that we have watched for some of the results; and they have come speedily enough in the shape of numerous letters from these struggling teachers. Their general opinion seems to be that if this is botany, they want no more of it. They are not to be blamed, for feeding on husks is never an inspiring diet; it only inspires a strong desire to leave the country of husks as speedily as possible. It is as if they were studying English literature, and instead of being directed to a study of the great masterpieces were told to memorize an English dictionary. In the "outline of study" which accompanies this glossary (by courtesy called a "botany"), a ludicrous attempt has been made to get into the current of laboratory methods. By a strange fatality, every plant whose examination is called for either does not grow in Indiana, or is to be secured months away from its natural time of appearance.

THE PROMINENT result of all this has been to disseminate a wide feeling of disgust for one of the most delightful of sciences; and the study of botany in the schools of the state has received a terrible backset. The possible movement for good, referred to in the opening sentence, is one just inaugurated by the Indiana Academy of Sciences, a thoroughly organized and vigorous body. The schools of the state and the scientific men are both so completely organized, that the influence of one can be easily brought in contact with the other. A committee of the Academy has been appointed to devise measures for securing a better grade of science teaching in the schools, and to attempt to counteract the influence of "reading circle" science. As the committee has been organized, not simply to draft resolutions, but to enter upon a practical campaign of hard work, we may look for some good results.

IT HAS OCCURRED to us that it would be well for scientific men all over the country to attack this problem in a more organized way. It is easily seen that as students pass from our well-equipped laboratories and become teachers in these schools, the leaven of scientific methods is slowly working its way through the mass. But as yet, the mass is so

vast, and the leaven is so small, that organized effort on the part of leaders in scientific work might hasten the movement.

* * *

THE SECOND part of Prof. Conway MacMillan's paper on "the three months course in botany" appears in *Education* for April. Had we anticipated another installment, we should have avoided a premature criticism, even inferentially, of his views, which are shown to be essentially in accord with those of the GAZETTE, ante, p. 120.

CURRENT LITERATURE.

Trelease on Epilobium.[1]

This is one of the most complete and satisfactory monographs we have seen. The genus is one of most perplexing character, for the species intergrade interminably. The author has wisely restrained himself from acknowledging as species all the forms that have been described as such, but he has felt compelled to publish several new ones. Not only is the geographical distribution of the species briefly considered, but the biological features connected with means of vegetative propagation, pollination, and dissemination, are noticed with that wealth of information and literature known to be in the possession of the author. The range is that of Gray's Synoptical Flora, here shown to contain 38 species of Epilobium. The new species are E. ursinum, E. holosericeum, E. delicatum, and E. clavatum, the first two from California, the others from the extreme N. W. states. Fourteen of the species admitted are those of Haussknecht. It would be impossible here to enumerate the changes in nomenclature involved by this monograph, as there has been such a confusion of names that only the monograph itself can make them clear. The names as they appear in Watson's Bibliographical Index are not very materially changed, but the separation of unrecognized species by Haussknecht has added many new names to that list. The illustration of every species is a very valuable feature of the work; and this leads us to remark, that accurate figures should be more extensively used in such monographs; for however faulty the text may be, good figures are records of facts that cannot well change, and are only second in value to the plants themselves.

[1] TRELEASE, WILLIAM.—The species of Epilobium occurring north of Mexico: 50 pp. 48 plates: 8 vo. [Reprinted from second annual report of the Mo. Bot. Garden: issued April 22, 1891.]

Baillon's "Histoire des Plantes."

The tenth volume of this great work, bearing the imprint of 1891, is at hand, and the American botanist always turns over its handsome pages with the greatest interest to discover the changes which affect his own plants. The present volume contains 476 pages, with 335 figures in the text, the families treated being Bignoniaceæ, Gesneriaceæ, Gentianaceæ, Apocynaceæ, Asclepiadaceæ, Convolvulaceæ, Polemoniaceæ, Boraginaceæ, and Acanthaceæ. In a somewhat hasty examination the following facts were noted with reference to North American plants:

GENTIANACEÆ.—*Frasera* Walt. is included under *Swertia* L.

APOCYNACEÆ.—Our single species of *Trachelospermum* is referred to *Forsteronia* G. F. W. Mey.; while the genus *Gelsemium* is included, having been transferred from Loganiaceæ.

ASCLEPIADACEÆ.—A wholesale merging of genera is made, by including *Gomphocarpus*, *Asclepiodora*, *Anantherix*, *Podostigma*, *Schizonotus*, and *Acerates* under *Asclepias*. *Vincetoxicum* Mœnch is placed under *Cynanchum* L.

CONVOLVULACEÆ.—*Calystegia* R. Br. is restored to generic rank, and *Bonamia* Dup.-Th. replaces *Breweria* R. Br.

POLEMONIACEÆ.—*Collomia* Nutt. is restored to generic rank, and all that was formerly *Gilia* becomes *Navarretia* Ruiz & Pav. Thus the name of one of our largest North American genera disappears, and a large harvest of species awaits the writer who first lists our species of *Navarretia*. How *Collomia* is kept distinct is not at all clear to the writer.

BORAGINACEÆ.—As is to be expected, the greatest changes are to be found in this much worked over group, and they are exceedingly hard to follow in any hasty review. However, the following facts seem clear: The whole family *Hydrophyllaceæ* appears under *Boraginaceæ*, and a well known ordinal name thus disappears. *Echinospermum* Swartz becomes *Lappula* Mœnch. *Eritrichium* Schrad. again appears with a part of its former species. *Cryptanthe* Lehm. also contains some former Eritrichiums. *Piptocalyx* Torr. stands for *Krynitzkia* Fisch. & Meyer. Professor Greene's genera *Eremocarya*, *Oreocarya*, *Allocarya*, and *Somnea* are admitted, containing species variously referred heretofore to *Eritrichium* and *Krynitzkia*. *Plagiobothrys* Fisch. & Mey. is maintained, and includes *Echidiocarya* Gray. *Hydrophyllum* becomes *Hydrophyllon*. *Nemophila* Nutt. is merged under *Ellisia* L. *Draperia* Torr. goes to *Phacelia* Juss. With such an upheaval in our generic lines it will be a work of considerable difficulty to properly locate our species.

ACANTHACEÆ.—*Gatesia* Gray is reduced to *Dianthera* L.

Minor Notices.

THE STUDY of aquatic plants is rapidly increasing. Since Dr. H. Schenck published his two large papers upon the anatomy and biology of these forms, a French botanist, Mr. C. Sauvageau has given some very exact observations upon the anatomy of several aquatic monocotyledons. It may be of interest to botanists in this country to know these works, which certainly encourage further studies. They are all published in *Journal de Botanique* and the titles are as follows: Sur un cas de protoplasme intercellulaire (1889); Sur la racine du *Najas* (1889); Contributions à l'étude du système mécanique dans la racine des plantes aquatiques: Les *Potamogeton* (1889); *ditto*: *Zostera*, *Cymodocea* et *Posidonia* (1889); Observations sur la structure des feuilles des plantes aquatiques: *Zostera*, *Cymodocea* et *Posidonia* (1890); Sur la feuille des *Hydrocharidées* marines: *Enhalus*, *Thalassia* et *Halophila* (1890): Sur la structure de la feuille des genres *Halodule* et *Phyllospadix* (1890); Sur la tige des *Zostera* (1891).—T. H.

PROFESSOR F. LAMSON-SCRIBNER is the author of a small, but very readable and useful book on fungous diseases of the grape and other plants, just published by J. T. Lovett Co., of Little Silver, N. J. The diseases of the grape have recently been receiving very large attention, and from no one more than Professor Scribner. He, therefore, speaks first-hand and does not merely compile current information. Other diseases treated are those of the apple, pear, peach, plum, etc. The diseases are not only described in a simple and recognizable way, but the best known treatment is suggested. The book should be in the possession of every horticulturist.

THE THIRD biennial report of the California State Board of Forestry, for the years 1889–90, has just appeared. It is a voluminous pamphlet of over 200 pages, but is full of information concerning the forests of California. The well-known botanist, Mr. J. G. Lemmon, has collected a vast array of facts, and his descriptions are always graphic. An invaluable part of the report will be found in the 30 artotype plates, representing the general habit of characteristic trees and sometimes even their detailed structures. These photographic reproductions are always useful, for they represent a set of facts of permanent value, no matter how opinions concerning them may change.

DR. ROLAND THAXTER has issued a paper on the Connecticut species of Gymnosporangium, as Bulletin 107 of the Connecticut Agricultural Experiment Station. A new species is characterized, viz. *G. nidus-avis*, the specific name referring to a "birds-nest" distortion it produces on Juniperus Virginiana. The Roestelia stage has been observed on quince and service-berry.

PROF. L. H. BAILEY has found time to write "The Nursery-book," a complete guide, not to the domestic matters which the first glance at its title will suggest, but to the multiplication and pollination of plants. The seven chapters have the following titles: Seedage, Separation; Layerage; Cuttage; Graftage; The Nursery List; Pollination. The book must be of great value to nurserymen, but it is also full of information and suggestion to the botanist, who has to teach, or who wants to experiment. It is published by the Rural Publishing Co. of N. Y. City.

MR. JOHN DONNELL SMITH has just issued the second part of his very handsome "Enumeratio Plantarum Guatemalensium." This part contains 100 pages of text, printed only on one side, and gives a full enumeration of all the Guatemalan plants collected by Mr. Smith and Baron von Türckheim since the appearance of the previous part. Certain groups have been distributed among specialists of this country and Europe, and the enumeration indicates a large number of new species.

FLORA FRANCISCANA, Part I, is the title of a new publication by our indefatigable friend, Professor E. L. Greene. As the author remarks on the title-page, this is "An attempt to classify and describe the vascular plants of middle California." Twenty orders are presented, beginning with Leguminosæ and ending with Caryophylleae, the obsolete distinction between Polypetalae and Apetalae being disregarded. One expects to find all sorts of departures from ordinary methods of classification, but the vast array of facts that have been collected by the direct field observation of a keen observer make this publication a very valuable one. Probably there always will be differences of opinion as to the drawing of ordinal, generic, and specific lines, but the facts, thus pigeon-holed according to the fancy of the observer, are permanent things. It would be impossible, in this notice, to call attention to the changes proposed, for this pamphlet of 128 pages contains in almost every page things interesting enough to be noted. However, Professor Greene's views are sufficiently well known to need no explanation. This part can be obtained for 75 cents, and it should be in the hands of every student of the Pacific slope flora.

THE CURRENT MEMOIR (vol. ii, no. 3) of the Torrey Botanical Club is by Mr. Theodore Holm, who presents a paper entitled "Contributions to the knowledge of the germination of some North American plants," handsomely illustrated by 15 plates. This paper deals with the description of the germination and early stage of growth and development of the rhizomes of certain plants. It must be said that

Mr. Holm is doing a very much needed piece of work, and such contributions to our knowledge of a very much neglected subject are exceedingly welcome. It is this kind of work which is laying up in store for the future systematist a set of facts that will make it more possible to present a natural classification.

FOUR ADDITIONAL PARTS (55 to 58) of *Die natürlichen Pflanzenfamilien* have lately appeared. No. 55 contains the beginning of the Cruciferae, by Prantl, in which the generic lines in vogue in America are maintained. No. 56 contains Cunoniaceae, by Engler; Pittosporaceae, by Pax; and Myrothamnaceae, Hamamelidaceae, Bruniaceae and Platanaceae, by Niedenzu. Nos. 57 and 58 contain the conclusion of Cruciferae, by Prantl; Moringaceae, Tovariaceae and Capparidaceae by Pax; Sarraceniaceae and Nepenthaceae by Wunschmann; Droseraceae by Drude; and Resedaceae by Hellwig.

A CATALOGUE of the "Flowering plants and higher cryptogams," both native and introduced, found within about 30 miles of Hanover, N. H., has just been published by Professor Henry G. Jesup, of Dartmouth College. An outline map is included, and about 60 pages of neat text present the names and habitats of the plants of a very interesting botanical region.

THE Trans. Kansas Acad. of Science, vol. xii (1889–90) is just at hand, and contains the following papers of botanical interest: Characteristic sand-hill flora (2 pp.), M. A. Carleton; Botanical notes for 1889 (2 pp.), J. H. Carruth; Methods of collecting, cleaning and mounting diatoms (2 pp.), Gertrude Crotty; Distribution and ravages of the hackberry branch knot (1 p. and 2 plates), Germination of Indian corn after immersion in hot water (2 pp. and 4 pp. of tables), Observations on the nutation of sunflowers, (3 pp. and 40 tables), W. A. Kellerman; Notes on sorghum smuts (2 pp. and 1 plate), Kellerman & Swingle; Evolution in leaves (4 pp. and 1 plate), Mrs. W. A. Kellerman; Radiation of heat from foliage (1 p.), A. G. Mayer; List of plants from Cherokee Co., Texas (2 pp.), Mrs. A. L. Slosson; Periodicity in plants (6 pp.), Additions to the flora of Kan. (14 pp.), B. B. Smyth; The union of Cuscuta glomerata with its host (1 p. and 1 figure), W. C. Stevens; First addition to the list of Kansas Peronosporaceae (5 pp.), W. T. Swingle; On the sugars of watermelons (1 p.), J. T. Willard.

OPEN LETTERS.

A plea for better botanical specimens.

An experience of five years in two of the large herbaria of this country, in which I have handled all the specimens as they came in from collectors all over the world, has confirmed my belief that too many botanists place a greater stress on quantity than quality. The distribution of C. G. Pringle's admirable specimens during the past few years, has produced among the fortunate few of his subscribers a change of opinion for the better; and the curators of herbaria, now crowded to overflowing with inferior specimens, are throwing more and more of the worthless material into the waste-basket. If exchanging botanists would give and demand none but good, complete specimens, the standard might be raised so that each addition to our numerous herbaria would be one of permanent value, not to occupy needed space until replaced by better specimens, some time in the far future.

A common fault is the breaking up of a single individual to make it go all around. Better one perfect and complete specimen in one herbarium, than many fragments in different places. Another common fault is the sending, as a complete specimen, a single individual of the smaller species. It betrays a small soul to ask that a single *Erigenia bulbosa* or *Viola blanda* shall count one in exchange. A fault in the opposite direction is the preparing of specimens too large for the herbarium sheet. I once mounted 200 species of grasses prepared by a professional collector, and every specimen that was more than sixteen inches tall, had to be moistened and pressed over.

Many extensive collectors even yet work as if picking flowers for a bouquet, in which the stem and radical leaves are not needed. The fruiting stage seems to pass unheeded by most collectors, unless they eat the fruit instead of sending it in, as there is a great dearth of fruit among the specimens and a corresponding demand for it by some of our systematic botanists.—L. H. Dewey, *Washington, D. C.*

Pachystima Canbyi in cultivation.

I notice in the March number of the Gazette that mention is made of the cultivation of *Pachystima Canbyi* in Germany. I have grown it in my garden here since 1875. I gathered it in S. W. Virginia in company with Mr. Howard Shriver in that year, and as it grew comparatively well under cultivation I have kept it in my grounds since. It is called locally "rat-stripper," from the readiness with which the bark strips off the wood, leaving a long white tail, as it were. I have sent many plants of it to various parts of Europe. The closely allied species, *P. Myrsinites*, from Oregon has not as yet proved hardy with me.—Geo. C. Woolson, *Passaic, N. J.*

NOTES AND NEWS.

DR. GEO. L. GOODALE has returned from his tour around the world.

A NEW GENUS of orchids, from Australia, Adelopetalum by name, is described by R. D. Fitzgerald in *Jour. Bot.* (May).

DR. LUCIEN M. UNDERWOOD has resigned his chair at Syracuse University to accept the professorship of botany at De Pauw University.

DECADES IX and X of Underwood and Cook's Hepaticae Americanae have been issued, and two more are almost ready for distribution.

DR. A. N. BERLESE has been called to the position of professor of botany and plant-pathology at the Royal School of Viticulture, at Avellino.

DR. W. A. SETCHELL, assistant in biology at Harvard University has been appointed to a similar position at Yale University. The department is under the charge of Prof. S. J. Smith.

IN THE *Journal of Botany* (May), the editor protests vigorously against Professor Henslow's theory of environment as an origin of species, as being a theory unsupported by facts.

DR. W. C. STURGIS, who has been assistant in cryptogamic botany at Harvard University has been appointed botanist to the Connecticut Agricultural Experiment *vice* Dr. Thaxter, resigned.

DR. B. L. ROBINSON, assistant in the Gray Herbarium for the past year, has been compelled to resign the position on account of ill health resulting from poisoning due to the arsenic used in preserving the specimens.

IN THE report of the Division of Forestry of the Department of Agriculture for 1890, it is shown that forestry is taught in the Agricultural Colleges of 17 states, and in 8 of them it is only incidentally touched upon.

VASEYANTHUS is a new genus of cucurbits from Lower California, described in *Zoe* (Feb.) by A. Cogniaux. Associated with Dr. George Vasey in the name is that of his assistant Mr. Rose, the plant appearing as V. Rosei.

A CATALOGUE of Nebraska phanerogams has been published by Professor Swezey, of Doane College, Crete, Nebr. The list, numbering 533 species and varieties, contains only those plants represented in the college herbarium.

DR. ROLAND THAXTER, of the Connecticut Agricultural Experiment station, has been elected assistant professor of the cryptogamic botany at Harvard University. In the probable absence of Dr. Farlow next year he will have charge of his work.

DR. AND MRS. BRITTON sailed for England June 6. Dr. B. takes a portion of Dr. Morong's S. American plants to Kew for determination and Mrs. B. expects to visit several of the bryological herbaria for study and comparison of American mosses.

In the third annual report of the Agricultural Experiment Station of West Virginia, the botanist, Dr. C. F. Millspaugh, speaks of a great variety of subjects, chiefly by way of instructing his constituency as to the noxious and useful plants of their flora.

Dr. Lucien M. Underwood spent several months of the past winter in collecting in Florida and Cuba for the Department of Agriculture. He brought back not only a considerable collection of Phanerogams, but also a large number of Hepaticae and Mosses.

Dr. E. Koehne, of Friedenau, well known as the editor of Just's *Jahresberichte*, and for his work upon the Lythraceae and other orders, has been invested with the title "Professor"—a title of more difficult acquisition, and hence more honorable, in Germany than in this country.

The poisoning of plants having proved ineffectual has been entirely abandoned at the Gray Herbarium. The tightness of cases and the handling of the sheets are relied upon to preserve the specimens. Any which become infested may be treated to a stay in CS_2 vapor, or some other insecticide.

In the *Bulletin of the Torrey Botanical Club* (May), Messrs. Anderson and Kelsey describe some new algae from Montana; Mr. Murray describes a new Myriophyllum from Michigan and calls it M. Farwellii from its discoverer; and Dr. Porter characterizes a new Liatris from North Carolina, to be known as L. Helleri. The Liatris is from the top of Blowing Rock Mt., Watauga Co.

In his notes on the histology of Polysiphonia fastigiata (*Jour. Bot.* May), Professor R. J. H. Gibson concludes that protoplasmic continuity is maintained only in young cells, and that the delicate strands which appear on both sides of the "plug" in older cells represent simply a delicate fringe arising from the margin of the plug itself and quite independent of the protoplasmic contents of the canal.

Professor Conway MacMillan, in *Amer. Nat.* (Feb.), gives an interesting table showing the comparative distribution southward of certain distinctly boreal genera of phanerogams by the Rocky and Appalachian mountain systems. The conclusion drawn is that the loftier mountain ranges have caused the extension southward of a correspondingly larger number of species. The table, as prepared, shows that twice as many species of northern genera have come southward along the twice as lofty Rocky Mountains as along the Appalachians.

M. Pierre Viala describes in the *Revue générale de Botanique* for April a disease of the vine which has caused considerable loss to the nurserymen in the central and southwestern parts of France during the past three years. The malady attacks the grafts and prevents the union of the stock and scion, which are usually kept for some time in sand in order to retard the growth of the buds until the proper season. Sclerotinia Fuckeliana is the cause of the trouble, and it seems to be transmitted from year to year in the sand. A thorough drying of this in the sun before using seems fatal to the spores and a preventive of the disease.

A PRIVATE LETTER from Lt. R. E. Peary, of the U. S. Navy, who proposes to attempt to reach the north pole on foot through Greenland, contains the following information that will be of interest to botanists: "I leave this country next June for Whale Sound, Greenland, from which point as a base I propose to determine the northern terminus of Greenland over the inland ice. I expect to be absent from 1½ to 2½ years. The region about Whale Sound is rich in Arctic plants, Kane having brought home 106 species of Phanerogams, and 42 species of Cryptogams, several of which were new. I am under the impression that with the exception of the above collection, and Hayes' from the same region, there are few plants from the Greenland higher latitude in this country, and that fresh specimens, subjected to modern methods of scientific research, would yield valuable results. Some specimens which I brought home from Greenland in 1886, have been considered valuable." Since the above was written, arrangements have been made with Lt. Peary to turn over his collections to the Philadelphia Academy of Sciences.

It is a well-known fact, that abnormally developed leaves are far from rare in nature, but one of the most peculiar forms is undoubtedly that to which Russell has called attention.[1] It is the so-called ascidia-form which has been observed in several families, although as a mere abnormity. The appearance of such leaves varies from cornet-like, where the two margins of the blade of a leaf have grown together at the base, to hood-like, where the margins are entirely united for their whole length. This last form has been observed by Russell, in the leaflets of the uppermost leaves of Vicia sepium, intermixed with cornet-shaped and normal ones. In these abnormal leaflets, the cells of the mesophyll have increased enormously in size, forming a nearly solid tissue. The shape of the cells of the two lowest strata of the mesophyll, especially those just under the inferior epidermis and close to the midrib, has also been transformed. They have become much higher than broad, very much like the palisade-tissue of the superior face. The fibro-vascular bundles have been moved towards the superior face of the blade, but have not been modified essentially. Chlorophyll was rather scarce in these abnormal leaflets. This transformation is due to puncture of an insect made in the superior epidermis. Larvae were found in the younger ascidia, probably belonging to a Cecidomyia.—T. H.

[1] Étude des folioles anormales du *Vicia sepium*: Revue générale de Botanique, no. 23.

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SOUTHERN PLANTS.

I shall have no class in Cryptogamic Botany in Cambridge this summer, but shall spend July to September collecting all kinds of botanical specimens in the Southern Alleghanies and on the Gulf Coast, giving special attention to *economic plants*, as *grasses* and *fungi*. I shall be pleased to correspond with persons wishing special collections made.

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